(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 378 002 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **01.12.93**

(51) Int. Cl.5: **A61B 17/16**, B23D 71/00, B23D 73/00

(21) Application number: **89313549.1**

(22) Date of filing: **22.12.89**

(54) **Bone rasp.**

(30) Priority: **09.01.89 US 295254**

(43) Date of publication of application:
18.07.90 Bulletin 90/29

(45) Publication of the grant of the patent:
01.12.93 Bulletin 93/48

(84) Designated Contracting States:
CH DE FR GB LI

(56) References cited:
EP-A- 0 033 398
DE-A- 2 236 014
GB-A- 836 051
US-A- 3 151 347
WO-A-88/05645
GB-A- 833 379
US-A- 2 847 048

MEDIZINISCH-ORTHOPÄDISCHE TECHNIK, vol. 108, no. 1, January/February 1988, pages 24-25, Stuttgart, DE; J. EICHLER: "Über eine Knochen-Raspel mit Motorantrieb"

MEDIZINISCH-ORTHOPÄDISCHE TECHNIK, vol. 104, no. 2, March-April 1984, page 48, Stuttgart, DE; J. EICHLER: "Über eine neue Raspel zur Bearbeitung von Knochenspongiosa"

(73) Proprietor: **MINNESOTA MINING AND MANUFACTURING COMPANY**
3M Center,
P.O. Box 33427
St. Paul, Minnesota 55133-3427(US)

(72) Inventor: **Alexson, Charles E. c/o Minnesota Mining and Manufacturing Company**
2501 Hudson Road
P.O. Box 33427 St. Paul Minnesota 55133(US)

(74) Representative: **Baillie, Iain Cameron et al**
c/o Ladas & Parry
Altheimer Eck 2
D-80331 München (DE)

EP 0 378 002 B1

Description

The invention relates generally to rasps, and more particularly to a rasp adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, and to a method of manufacturing rasps.

Background of the Invention

Orthopedic surgeons frequently desire smoother cut surfaces than they have been able to consistently obtain by sawing a section of bone, e.g., for secure engagement with a suitable prosthesis. Sometimes surgeons attempt to smooth out a freshly cut surface by running the side of the saw blade along the surface, possibly leading to bone necrosis (i.e., bone cell death) due to overheating if the saw is run too long. However, if the surgeon does not obtain a sufficiently smooth surface the time required for the patient's recovery may be increased, the strength of a bond between the bone and a prosthesis may be impaired, and the reliability of the prosthesis may even be jeopardized. If the surface is so uneven that substantial portions of the bone remain unloaded, the unloaded portion of the bone may resorb or dissolve into the body, causing further weakening of the bone and the bond between the bone and prosthesis.

From Medizinisch-Orthopädische Technik, vol. 108, no. 1, January/February 1988, pages 24-25, Stuttgart DE, a rasp according to the preamble of claim 1 is known.

Summary of the Invention

The invention provides a rasp adapted for substantially evenly rasping generally hard tissue, such as bone, cartilage and associated tissue to obtain a smooth surface to, for example, enhance bonding with a prosthesis, and a method of manufacturing such a rasp. The rasp is designed to be readily attached to and detached from a powered surgical device, and is designed to avoid clogging of the cutting surfaces of the rasp by the tissue.

Generally, the rasp of the invention comprises a generally plate-like body having opposite generally parallel major surface portions, and attaching means on the body for detachably attaching the rasp to a powered device for driving the rasp. A plurality of rasp portions are arranged along the rasp for substantially evenly rasping hard tissue. Each rasp portion has a center, and a plurality of slots through the body extending generally radially outwardly from the center of the portion to define a plurality of cantilever cutting members extending generally radially inwardly of the rasp portion generally toward the center of the rasp portion and separated from one another by the slots. The cutting members are bent to project outwardly from the major surface portions of the body, with alternating members of each rasp portion being bent to project outwardly from alternating major surface portions of the body.

The method of manufacturing the rasp includes the steps of providing a hardened stainless steel plate having opposite generally parallel major surfaces, and forming means on the plate for detachably attaching the rasp to a powered device for driving the rasp. A plurality of rasp portions are arranged along the rasp for substantially evenly rasping hard tissue. Each rasp portion is formed by laser cutting a plurality of slots through the plate to extend generally radially outwardly from a center to a perimeter to define a plurality of cantilever cutting members extending radially inwardly of the rasp portion, and bending the cutting members to project outwardly from the major surfaces of the plate with alternating members of the rasp portion being bent outwardly from alternating respective major surfaces of the plate.

Other features will be in part apparent and in part pointed out hereinafter.

Brief Description of the Drawing

The invention will be further described with reference to the drawing wherein corresponding reference characters indicate corresponding parts throughout the several views of the drawing, and wherein:

Fig. 1 is a top plan view of a rasp of the invention, illustrating a preferred arrangement of rasp portions along the rasp;

Fig. 2 is an enlarged fragmentary top plan view of one of the rasp portions of Fig. 1; and

Fig. 3 is a cross-sectional view substantially along line 3-3 of Fig. 2.

Detailed Description

As shown in Fig. 1, a rasp of the invention is designated in its entirety by the reference numeral 10. The rasp 10 is adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue. The rasp 10 is designed to be attached to a source of oscillating-pivoting motion via some type of releasable attaching mechanism (not shown), such as the attaching assembly for an osteotomy saw blade disclosed in U.S. Pat. No. 4,386,609, or the quick release mechanism for surgical devices disclosed in U.S. Pat. No. 3,943,934. As used herein, "rasp" refers to a rasp blade, body or generally plate-like structure, and is not intended to be limited to such a rasp blade, body or plate-like struc-

ture in combination with a power source, or the mechanism for attaching the rasp to the power source.

The rasp 10 generally comprises an elongate generally plate-like body 12 of hardened stainless steel, such as 301/302 SST full hard stainless steel. As used herein, "plate-like" refers to the substantially flat surfaces of the body 12, and does not require a circular outline. The body 12 has opposite generally parallel major surface portions or sides 14 and 16, and a thickness between the surfaces 14 and 16 of, for example, approximately 1mm (0.04 in.). Means 18 is provided on the body 12 for detachably attaching the rasp 10 to a powered device (not shown) for driving the rasp 10, for example, via one of the attaching assemblies discussed above. A plurality of rasp portions 20 are suitably arranged along the rasp 10 for substantially evenly rasping hard tissue.

As shown in Fig. 2, each rasp portion 20 has an open center 22, and a plurality of slots 24 through the body 12 extending generally radially outwardly from the center 22 of the portion 20. The slots 24 define a plurality (e.g., 6) of cantilever cutting members 26A, 26B extending generally radially inwardly of the rasp portion 20 generally toward the center 22 of the rasp portion 20. The cutting members 26A, 26B are separated from one another by the slots 24. The cutting members 26A, 26B are bent to project outwardly from the major surface portions 14 and 16 of the body 12, with alternating members 26A or 26B of each rasp portion 20 being bent to project outwardly from alternating respective major surface portions 14 or 16 of the body 12 so that either surface portion 14 or 16 may be used for rasping. That is, the three cutting members designated 26A are bent to project outwardly of respective surface portion 14 (upwardly in Fig. 3), and the three cutting members designated 26B are bent to project outwardly of respective surface portion 16 (downwardly in Fig. 3).

The center 22 and slots 24 of each rasp portion 20 are preferably laser-cut through the body by a carbon-dioxide laser, such as the laser sold under the trade designation "Trumatic 180 type 93031" by Trumpf G.m.b.H. & Co. of Ditzingen, West Germany, or the "Model VA15" laser sold by Lumonics Material Processing Corp. of Eden Prairie, Minnesota. Each slot 24 is cut to have a width W (Fig. 2) sufficiently great to permit rasped tissue to flow through the slots 24 during rasping (e.g., a width W of approximately 0.1-1mm, preferably 0.2mm, separating adjacent cutting members).

Each cutting member 26A, 26B is generally triangular (Fig. 2), and has a free cutting point 28A or 28B spaced approximately 0.2-2mm (preferably 0.3-0.7mm) from the respective major surface portion 14 or 16 of the body 12. The perimeter of each rasp portion 20 is generally hexagonal, as defined by the attached bases of the six cutting members 26A, 26B. Each cutting member 26A, 26B extends generally radially inwardly from a respective side of the hexagonal perimeter toward the center 22 of the rasp portion 20. The cutting members 26A, 26B are bent outwardly from the major surface portions 14 and 16 of the body 12 at an angle A (Fig. 3) of approximately 10-45 degrees (preferably 20-25 degrees) with respect to the respective major surface portion 14 or 16, and each cutting member 26A, 26B has a length L of approximately 2-4mm (e.g., 2.4mm) between the free cutting point 28A or 28B and the perimeter of the rasp portion 20. The free cutting points 28A, 28B of the members 26A and 26B of each rasp portion 20 approximately define surface points along an imaginary cylinder having a diameter of approximately 0.1-3mm (e.g., 0.8mm), and a central longitudinal axis AX-1 generally perpendicular to the major surface portions 14 and 16 of the body 12.

As shown in Fig. 1, the rasp portions 20 are arranged in a pattern wherein there is increasing spacing between the rasp portions 20 in the direction away from the center C-1 of the attaching means 18 (downwardly in Fig. 1), which is also the center of pivoting-oscillating motion when the rasp 10 is being used. For example, the rasp portions 20 may be arranged along substantially equally-spaced radial lines RL extending generally radially outwardly from the center C-1 of the attaching means 18 at approximately two degree intervals. Because the radial lines RL diverge from one another in the direction away from the center C-1 of the attaching means 18, the rasp portions 20 are spaced farther apart adjacent the outward end 30 (downward end in Fig. 1) of the rasp 10 than they are closer to the center C-1. Greater spacing of cutting surfaces (rasp portions) adjacent the outward end 30 facilitates even rasping of tissue, since the outward end 30 of the rasp 10 is the fastest moving part of the rasp during use.

More specifically, the rasp portions 20 are arranged along the radial lines RL in staggered arcuate rows R-1 (and preferably R-2 and R-3) extending obliquely with respect to the radial lines RL and with respect to the direction of oscillating motion. The rasp portions 20 of any row R-1, R-2, or R-3 are staggered with respect to the intended direction of motion of the rasp 10. For example, each row R-1 is staggered with respect to one of the series of circumferences CR about the center C-1 of the attaching means 18 that are arranged serially outwardly from the center C-1. The intersecting arcuate rows R-1, R-2, and R-3, along which the rasp portions 20 are arranged, are preferably substantially centered with respect to an

axis or center offset from the center C-1 of the attaching means 18 (e.g., R-1 may be arcuate about a center C-2). Rows R-1 are preferably spaced farther apart in the direction toward the outward end 30 of the rasp 10.

The attaching means 18 may comprise a specially-configured inward end portion 32 (Fig. 1) of the body 12 opposite the outward end 30, similar to the end portion described in U.S. Pat. No. 4,386,609, although other types of attaching means are also contemplated. A through aperture 34 is formed between the major surface portions 14 and 16. The through aperture 34 includes a narrow aperture portion 36 defined by spaced parallel walls opening through the inward (upward in Fig. 1) end or edge of the body 12, and a larger aperture portion 38 spaced from the inward edge of the body 12 and defined by octagonally arranged walls, as illustrated in Fig. 1, but which could be defined by a circular wall. A projection 40 from one of the major surface portions, e.g., 14, may be provided generally adjacent the through aperture 34 centrally of the width of the body 12 and between the aperture 34 and the rasp portions 20.

Claims

1. A rasp (10) adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, the rasp (10) comprising a generally plate-like body (12) having opposite generally parallel major surface portions (14,16), attaching means (18) on the body (12) for detachably attaching the rasp (10) to a powered device for driving the rasp (10), and a plurality of rasp portions (20) arranged along the rasp (10) for substantially evenly rasping hard tissue, characterized in that each rasp portion (20) has a center (22), and a plurality of slots (24) through the body (12) extending generally radially outwardly from the center (22) of the portion (20) to define a plurality of cantilever cutting members (26A, 26B) extending generally radially inwardly of the rasp portion (20) generally toward the center (22) of the rasp portion (20) and separated from one another by the slots (24), the cutting members (26A, 26B) being bent to project outwardly from the major surface portions (14, 16) of the body (12) with alternating members (26A or 26B) of each rasp portion (20) being bent to project outwardly from opposite surface portions (14 or 16) of the body (12).

2. A rasp (10) according to claim 1 wherein the slots (24) have a width of approximately 0.1 - 1mm separating adjacent cutting members to permit rasped tissue to flow through the slots (24) during rasping.

3. A rasp (10) according to claim 2 wherein each cutting member (26A, 26B) is generally triangular, and has a free cutting point (28A or 28B) spaced approximately 0.2-2mm from a respective major surface portion (14 or 16) of the body (12), the cutting members (26A, 26B) being bent outwardly from a respective major surface portion (14 or 16) of the body (12) at an angle of approximately 10-45 degrees with respect to the major surface portions (14, 16) of the body (12).

4. A rasp (10) according to claim 1 wherein the attaching means (18) is adapted for detachably attaching the rasp (10) to a source of oscillating motion, the rasp portions (20) being arranged along substantially equally-spaced radial lines (RL) extending generally radially outwardly from the center (C-1) of the attaching means (18) so that the rasp portions (20) are arranged along substantially equally-spaced lines (RL) extending generally radially outwardly from the center (C-1) of oscillating motion when the rasp (10) is oscillating, the rasp portions (20) being arranged along the radial lines (RL) in staggered rows (R-1) extending obliquely with respect to the radial lines (RL) and with respect to the direction of oscillating motion.

5. A rasp according to claim 4 wherein the rasp portions are also arranged along arcs (R-1, R-2 or R-3) centered with respect to an axis (C-2) offset from the attaching means (18).

6. A method of manufacturing a rasp (10) adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, the method comprising the following steps:

providing a hardened stainless steel plate (12) having opposite generally parallel major surfaces (14, 16);

forming attaching means (18) on the plate (12) for detachably attaching the rasp (10) to a powered device for driving the rasp (10); and

forming a plurality of rasp portions (20) arranged along the rasp (10) for substantially evenly rasping hard tissue, including the steps of forming each rasp portion (20) by:

laser cutting a plurality of slots (24) through the plate (12) to extend generally radially outwardly from a center (22) to a perimeter to define a plurality of cantilever cutting members (26A, 26B) extending radially inwardly of the rasp portion (20); and

bending the cutting members (26A, 26B)

to project outwardly from the major surfaces (14, 16) of the plate (12) with alternating members (26A or 26B) of the rasp portion (20) being bent outwardly from alternating respective major surfaces (14 or 16) of the plate (12).

7. A method according to claim 6 wherein the step of laser-cutting a plurality of slots (24) includes laser-cutting the slots (24) to have a width of approximately 0.1-1mm separating adjacent cutting members (26A and 26B) and to define the cutting members (26A, 26B) as generally triangular and having a free cutting point (28A or 28B), and the step of bending the cutting members (26A, 26B) includes bending each cutting member (26A or 26B) such that its free cutting point (28A or 28B) is spaced approximately 0.2-2mm from its respective major surface (14 or 16) of the plate (12).

8. A method according to claim 7 wherein the step of laser-cutting a plurality of slots (24) includes cutting the slots (24) with a carbon dioxide laser to define six of the aforesaid cutting members (26A, 26B) in each rasp portion (20), with each cutting member (26A, 26B) having a length of approximately 2-4mm extending generally radially inwardly from a respective side of a hexagonal perimeter of the portion to the free cutting point (28A or 28B); the step of bending the cutting members (26A, 26B) including bending the members (26A, 26B) outwardly from the opposite major surfaces (14, 16) of the plate (12) at an angle of approximately 10-45 degrees with respect to the major surfaces (14, 16) of the plate (12), with the free cutting points (28A, 28B) of the members (26A, 26B) of each rasp portion (20) approximately defining surface points along a cylinder having a diameter of approximately 0.1-3mm and a central longitudinal axis (AX-1) generally perpendicular to the major surfaces (14, 16) of the plate (12).

9. A method according to claim 6 wherein the attaching means (18) is adapted for detachably attaching the rasp (10) to a source of oscillating motion, the step of forming rasp portions (20) including the step of arranging the rasp portions (20) substantially equally-spaced radial lines (RL) extending generally radially outwardly from the center (C-1) of the attaching means (18) so that the rasp portions (20) are arranged along substantially equally-spaced lines (RL) extending generally radially outwardly from the center (C-1) of oscillating motion when the rasp (20) is oscillating, the step of arranging the rasp portions (20) further including arranging the rasp portions (20) along the radial lines (RL) in staggered rows (R-1, R-2 and/or R-3) extending obliquely with respect to the radial lines (RL) and with respect to the direction of oscillating motion.

10. A method according to claim 9 wherein the step of arranging the rasp portions (20) further includes arranging the rasp portions (20) along arcs (R-1, R-2 and/or R-3) centered with respect to an axis (C-2) offset from the attaching means (18).

Patentansprüche

1. Raspel (10), die zum Raspeln von allgemein hartem Gewebe, wie etwa Knochen, Knorpel und zugeordnetem Gewebe, adaptiert ist, dadurch gekennzeichnet, daß die Raspel (10) folgendes umfaßt: einen allgemein plattenartigen Körper (12), der gegenuberliegende, allgemein parallele Hauptoberflächenteile (14, 16) aufweist, eine Befestigungseinrichtung (18) an dem Körper (12) zur demontierbaren Befestigung der Raspel (10) an einer Antriebsvorrichtung zum Antrieb der Raspel (10), wobei eine Mehrzahl von Raspelteilen (20) auf der Raspel (10) angeordnet ist, um das harte Gewebe im wesentlichen gleichmäßig zu raspeln, dadurch gekennzeichnet, daß jeder Raspelteil (20) eine Mitte (22) aufweist, sowie eine Mehrzahl von Schlitzen (24) durch den Körper (12), die sich sich allgemein radial von der Mitte (22) des Teils (20) nach außen erstrecken, um so eine Mehrzahl von Auslegerschneideelementen (26A, 26B) zu definieren, die sich allgemein von dem Raspelteil (20) radial nach innen erstrecken, in Richtung der Mitte (22) des Raspelteils (20), wobei die Elemente durch die Schlitze (24) voneinander getrennt sind, wobei die Schneideelemente (26A, 26B) gebogen sind, so daß sie von den Hauptoberflachenteilen (14, 16) des Körpers vorstehen, wobei abwechselnde Elemente (26A oder 26B) jedes Raspelteils (20) so gebogen sind, daß sie von gegenüberliegenden Oberflächenteilen (14 oder 16) des Körpers (12) nach außen vorstehen.

2. Raspel (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Schlitze (24) eine Breite von etwa 0,1 - 1 mm aufweisen, um nebeneinanderliegende Schneideelemente zu trennen, um so zu ermöglichen, daß geraspeltes Gewebe beim Raspeln durch die Schlitze (24) strömen kann.

3. Raspel (10) nach Anspruch 2, dadurch gekennzeichnet, daß jedes Schneideelement (26A, 26B) allgemein dreikantig ist und eine freie Schneidestelle (28A oder 28B) aufweist, die etwa mit einem Abstand von 0,2 bis 2 mm von einem entsprechenden Hauptoberflächenteil (14 oder 16) des Körpers (12) angeordnet ist, wobei die Schneideelemente (26A, 26B) von dem entsprechenden Hauptoberflachenteil (14 oder 16) des Körpers (12) in einem Winkel von etwa 10 bis 45 Grad bezüglich der Hauptoberflächenteile (14, 16) des Körpers (12) gebogen sind.

4. Raspel (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Befestigungseinrichtung (18) so adaptiert ist, daß sie die Raspel (10) demontierbar an einer Drehbewegungsquelle angebringt, wobei die Raspelteile (20) entlang von Radiallinien (RL), mit gleichen Zwischenräumen, angeordnet sind, die sich allgemein von der Mitte (C-1) der Befestigungseinrichtung (18) radial nach außen erstrecken, so daß die Raspelteile (20) entlang von Linien (RL) mit im wesentlichen gleichen Zwischenräumen angeordnet sind, wobei sich die Linien allgemein von der Mitte (C-1) der Drehbewegung erstrekken, wenn sich die Raspel (10) dreht, wobei die Raspelteile (20) entlang der Radiallinien (RL) in versetzten Reihen (R-1) angeordnet sind, die sich in bezug auf die Radiallinien (RL) und die Richtung der Drehbewegung kreuzweise erstrecken.

5. Raspel nach Anspruch 4, dadurch gekennzeichnet, daß die Raspelteile ferner entlang von Bögen (R-1, R-2 oder R-3) angeordnet sind, zentriert in bezug auf eine von der Befestigungseinrichtung (18) versetzte Achse (C-2).

6. Verfahren zur Herstellung einer Raspel (10), die zum Raspeln von allgemein hartem Gewebe, wie etwa Knochen, Knorpel und zugeordnetem Gewebe, adaptiert ist, dadurch gekennzeichnet, daß das Verfahren die folgenden Schritte umfaßt:

Bereitstellung einer gehärteten Platte (12) aus rostfreiem Stahl, die gegenüberliegende, allgemein parallele Hauptoberflächen (14, 16) aufweist;

Gestaltung einer Befestigungseinrichtung (18) an der Platte (12), zur demontierbaren Anbringung der Raspel (10) an einer Antriebsvorrichtung zum Antrieb der Raspel (10); und

Gestaltung einer Mehrzahl von Raspelteilen (20), die entlang der Raspel (10) angeordnet sind, um hartes Gewebe im wesentlichen gleichmäßig zu raspeln, umfassend die Schritte zur Gestaltung jedes Raspelteils (20), durch:

Laserschneiden einer Mehrzahl von Schlitzen (24) durch die Platte (12), so daß sie sich allgemein von einer Mitte (22) bis zu einer Begrenzung nach außen erstrecken, um so eine Mehrzahl von Auslegerschneideelementen (26A, 26B) zu definieren, die sich radial von dem Raspelteil (20) nach innen erstrecken; und

Biegen der Schneideelemente (26A, 26B), so daß sie von den Hauptoberflächen (14, 16) der Platte (12) nach außen vorstehen, wobei abwechselnde Elemente (26A, 26B) des Raspelteils (20) von abwechselnden entsprechenden Hauptoberflächen (14 oder 16) der Platte (12) nach außen gebogen sind.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß der Schritt des Laserschneidens einer Mehrzahl von Schlitzen (24) das Laserschneiden von Schlitzen (24) umfaßt, die eine Breite von etwa 0,1 bis 1 mm aufweisen und nebeneinanderliegende Schneideelemente (26A und 26B) voneinander trennen und um so die Schneideelemente (26A, 26B) allgemein als dreikantig zu definieren, mit einer freien Schneidestelle (28A, 28B) und wobei der Schritt des Biegens der Schneideelemente (26A, 26B) das Biegen jedes Schneideelements (26A oder 26B) umfaßt, so daß sich die freie Schneidestelle (28A oder 28B) jedes Schneideelements in einem Abstand von etwa 0,2 bis 2 mm zu der entsprechenden Hauptoberfläche (14 oder 16) der Platte (12) befindet.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der Schritt des Laserschneidens einer Mehrzahl von Schlitzen (24) das Schneiden der Schlitze (24) mit einem Kohlendioxid-Laser umfaßt, um so sechs der vorgenannten Schneideelemente (26A, 28A) in jedem Raspelteil (20) zu definieren, wobei jedes Schneideelement (26A, 28A) eine Länge von etwa 2 bis 4 mm aufweist und sich dabei allgemein radial nach innen von einer entsprechenden Seite einer hexagonalen Begrenzung des Teils zu der freien Schneidestelle (28A oder 28B) erstreckt; dadurch gekennzeichnet, daß der Schritt des Biegens der Schneideelemente (26A, 26B) den Schritt des Biegens der Elemente (26A, 26B) nach außen von den gegenüberliegenden Hauptoberflächen (14, 16) der Platte (12) umfaßt, und zwar in einem Winkel von etwa 10-45 Grad in bezug auf die Hauptoberflächen (14, 16) der Platte (12), wobei die freien Schneidestellen (28A, 28B) der Elemente (26A, 26B) jedes Raspelteils (20) ungefähr die Oberflächenstellen entlang eines Zylinders

mit einem Durchmesser zwischen etwa 0,1 bis 3 mm und einer Längsachse (AX-1), die allgemein senkrecht zu den Hauptoberflächen (14, 16) der Platte (12) ist, definieren.

9. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß die Befestigungseinrichtung (18) zur demontierbaren Anbringung der Raspel (10) an einer Drehbewegungsquelle adaptiert ist, wobei der Schritt der Gestaltung der Raspelteile (20) den Schritt der Anordnung der Raspelteile (20) an Radiallinien (RL) mit im wesentlichen gleichen Zwischenräumen umfaßt, die sich von der Mitte (C-1) der Befestigungseinrichtung (18) allgemein radial nach außen erstrecken, so daß die Raspelteile (20) entlang von Linien (RL) mit im wesentlichen gleichen Zwischenräumen angeordnet sind, wobei sich die Linien von der Mitte (C-1) der Drehbewegung allgemein radial nach außen erstrecken, wenn sich die Raspel (20) dreht, dadurch gekennzeichnet, daß der Schritt der Anordnung der Raspelteile (20) ferner die Anordnung der Raspelteile (20) entlang der Radiallinien (RL) in versetzten Reihen (R-1, R-2 und/oder R-3) umfaßt, wobei sich diese Reihen in bezug auf die Radiallinien (RL) und auf die Richtung der Drehbewegung kreuzweise erstrecken.

10. Verfahren nach Anspruch 9, dadurch gekennzeichnet, daß der Schritt der Anordnung der Raspelteile (20) ferner die Anordnung der Raspelteile (20) entlang von Bögen (R-1, R-2 und/oder R-3) umfaßt, zentriert in bezug auf eine von der Befestigungseinrichtung (18) versetzte Achse (C-2).

Revendications

1. Râpe (10) prévue pour râper un tissu généralement dur,tel qu'un os, un cartilage et un tissu associé, la râpe (10) comprenant un corps sensiblement en forme de plaque (12) qui présente des grandes surfaces opposées sensiblement parallèles (14,16), des moyens d'attache (18) prévus sur le corps (12) pour attacher de façon séparable la râpe (10) à un dispositif à moteur d'entraînement de la râpe (10) , et une pluralité de parties râpeuses (20) agencées le long de la râpe (10) pour râper sensiblement régulièrement un tissu dur, caractérisée en ce que chaque partie râpeuse (20) comprend un centre (22) et une pluralité de fentes (24) qui traversent le corps (12) et s'étendent sensiblement radialement vers l'extérieur à partir du centre (22) de la partie (20) de manière à définir une pluralité d'éléments coupants en porte-à-faux (26A,26B) s'étendant sensiblement radialement vers l'intérieur de la partie râpeuse (20), sensiblement vers le centre (22) de la partie râpeuse (20) et séparés les uns des autres par les fentes (24), les éléments coupants (26A,26B) étant pliés de manière à faire saillie vers l'extérieur par rapport aux grandes surfaces (14,16) du corps (12), les éléments alternés (26A ou 26B) de chaque partie râpeuse (20) étant pliés de manière à faire saillie vers l'extérieur par rapport aux surfaces opposées alternées (14 ou 16) du corps (12).

2. Râpe (10) suivant la revendication 1, dans laquelle les fentes (24) ont une largeur de 0,1 à 1 mm environ, séparant les éléments coupants adjacents pour permettre au tissu râpé de s'évacuer à travers les fentes (24) pendant le râpage.

3. Râpe (10) suivant la revendication 2, dans laquelle chaque élément coupant (26A,26B) est sensiblement triangulaire et présente une pointe coupante libre (28A ou 28B) espacée de 0,2 à 2 mm environ d'une grande surface respective (14 ou 16) du corps (12), les éléments coupants (26A,26B) étant pliés vers l'extérieur par rapport à une grande surface respective (14 ou 16) du corps (12) suivant un angle de 10 à 45 degrés environ par rapport aux grandes surfaces (14,16) du corps (12).

4. Râpe (10) suivant la revendication 1, dans laquelle les moyens d'attache (18) sont prévus pour attacher de façon séparable la râpe (10) à une source de mouvement oscillant, les parties râpeuses (20) étant disposées le long de lignes radiales (RL) sensiblement également espacées et s'étendant sensiblement radialement vers l'extérieur à partir du centre (C-1) des moyens d'attache (18) de sorte que les parties râpeuses (20) se trouvent le long de lignes sensiblement également espacées (RL) s'étendant sensiblement radialement vers l'extérieur à partir du centre (C-1) de mouvement oscillant lorsque la râpe (10) oscille, les parties râpeuses (20) étant agencées le long des lignes radiales (RL) en rangées décalées (R-1) qui s'étendent obliquement par rapport aux lignes radiales (RL) et par rapport à la direction du mouvement oscillant.

5. Râpe suivant la revendication 4, dans laquelle les parties râpeuses sont également agencées le long d'arcs (R-1,R-2 ou R-3) centrés par rapport à un axe (C-2) décalé des moyens d'attache (18).

6. Méthode de fabrication d'une râpe (10) prévue pour râper un tissu généralement dur, tel qu'un os, un cartilage et un tissu associé, la méthode comprenant les étapes suivantes :

la préparation d'une plaque en acier inoxydable durci (12) ayant de grandes surfaces opposées sensiblement parallèles (14,16) ;

la formation de moyens d'attache (18) sur la plaque (12) pour attacher de façon séparable la râpe (10) à un dispositif à moteur d'entraînement de la râpe (10) ; et

la formation d'une pluralité de parties râpeuses (20) agencées le long de la râpe (10), pour râper sensiblement régulièrement un tissu dur, incluant les opérations de formation de chaque partie râpeuse (20) par :

découpe au laser d'une pluralité de fentes (24), à travers la plaque (12), qui s'étendent sensiblement radialement vers l'extérieur à partir d'un centre (22) jusqu'à un périmètre pour définir une pluralité d'éléments coupants en porte-à-faux (26A,26B) qui s'étendent radialement vers l'intérieur de la partie râpeuse (20) ; et

pliage des éléments coupants (26A,26B) de manière qu'ils fassent saillie vers l'extérieur par rapport aux grandes surfaces (14,16) de la plaque (12), les éléments alternés (26A ou 26B) de la partie râpeuse (20) étant pliés vers l'extérieur par rapport aux grandes surfaces respectives alternées (14 ou 16) de la plaque (12).

7. Méthode suivant la revendication 6, dans laquelle l'étape de découpe au laser d'une pluralité de fentes (24) comprend la découpe au laser des fentes (24) à une largeur de 0,1 à 1 mm environ séparant les éléments coupants adjacents (26A et 26B) et de manière à définir les éléments coupants (26A,26B) de forme sensiblement triangulaire et présentant une pointe coupante libre (28A ou 28B), et l'étape de pliage des éléments coupants (26A,26B) comprend le pliage de chaque élément coupant (26A ou 26B) de sorte que sa pointe coupante libre (28A ou 28B) soit espacée de 0,2 à 2 mm environ de sa grande surface respective (14 ou 16) de la plaque (12).

8. Méthode suivant la revendication 7, dans laquelle l'étape de découpe au laser d'une pluralité de fentes (24) comprend la découpe des fentes (24) au moyen d'un laser à CO_2 pour définir six des éléments coupants précités (26A,26B) dans chaque partie râpeuse (20), chaque élément coupant (26A,26B) ayant une longueur de 2 à 4 mm environ et s'étendant sensiblement radialement vers l'intérieur à partir d'un côté respectif d'un périmètre hexagonal de la partie râpeuse, jusqu'à la pointe coupante libre (28A ou 28B) ; l'étape de pliage des éléments coupants (26A,26B) comprend le pliage des éléments (26A,26B) vers l'extérieur par rapport aux grandes surfaces opposées (14,16) de la plaque (12) suivant un angle de 10 à 45 degrés environ par rapport aux grandes surfaces (14,16) de la plaque (12), les pointes coupantes libres (28A,28B) des éléments coupants (26A,26B) de chaque partie râpeuse (20) définissant approximativement des points de surface le long d'un cylindre ayant un diamètre de 0,1 à 3 mm environ et un axe longitudi nal central (AX-1) sensiblement perpendiculaire aux grandes surfaces (14,16) de la plaque (12).

9. Méthode suivant la revendication 6, dans laquelle les moyens d'attache (18) sont prévus pour attacher de façon séparable la râpe (10) à une source de mouvement oscillant, l'étape de formation des parties râpeuses (20) incluant l'étape d'agencement des parties râpeuses (20) sensiblement suivant des lignes radiales également espacées (RL) qui s'étendent sensiblement radialement vers l'extérieur à partir du centre (C-1) des moyens d'attache (18) de sorte que les parties râpeuses (20) se trouvent le long de lignes sensiblement également espacées (RL) qui s'étendent sensiblement radialement vers l'extérieur à partir du centre (C-1) du mouvement oscillant lorsque la râpe (10) oscille, l'étape d'agencement des parties râpeuses (20) comprenant en outre l'agencement des parties râpeuses (20) le long des lignes radiales (RL) en rangées décalées (R-1,R-2 et/ou R-3) qui s'étendent obliquement par rapport aux lignes radiales (RL) et par rapport à la direction du mouvement oscillant.

10. Méthode suivant la revendication 9, dans laquelle l'étape d'agencement des parties râpeuses (20) comprend en outre l'agencement des parties râpeuses (20) le long d'arcs (R-1, R-2 et/ou R-3) centrés sur un axe (C-2) décalé par rapport aux moyens d'attache (18).

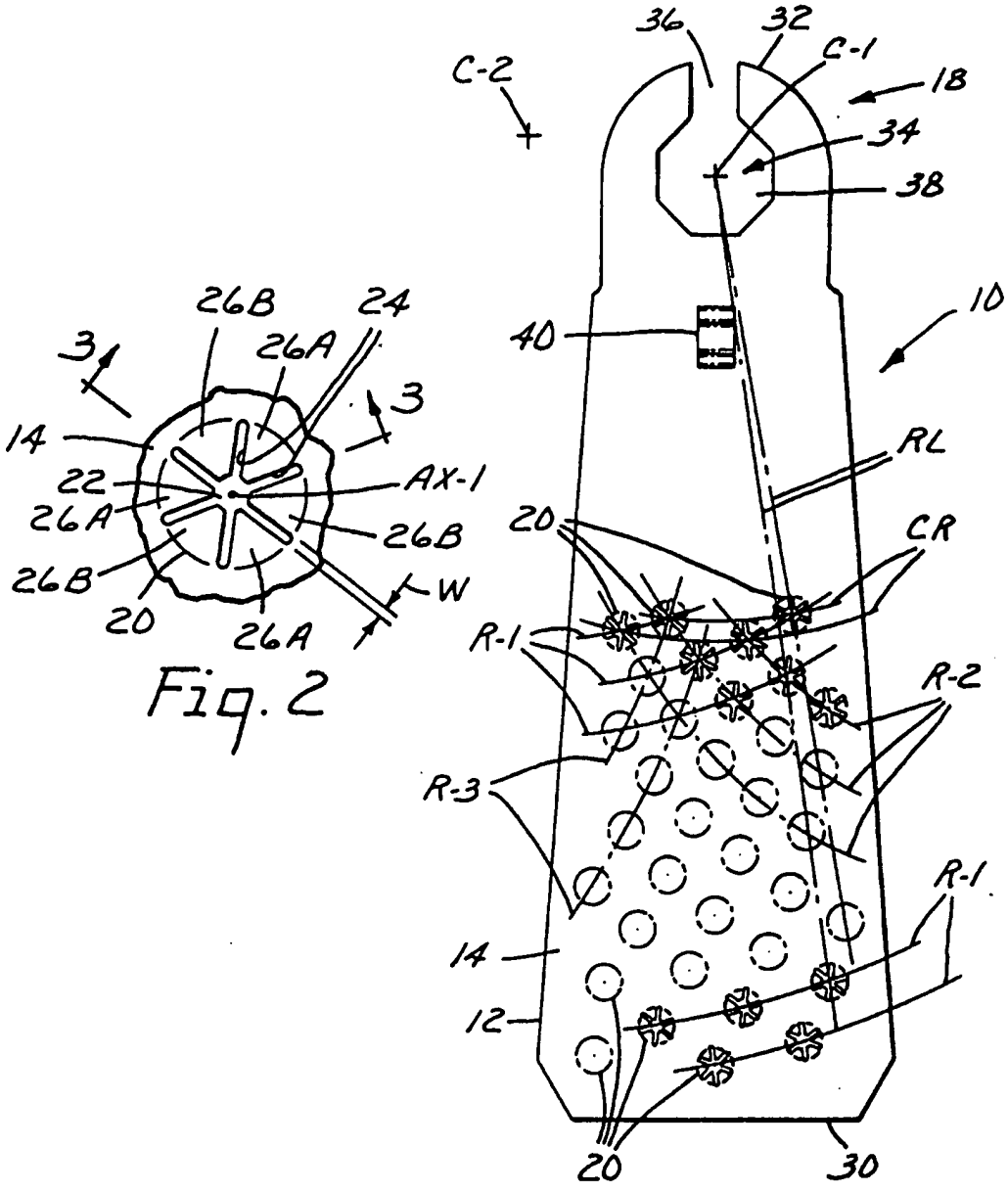

Fig. 1

Fig. 2

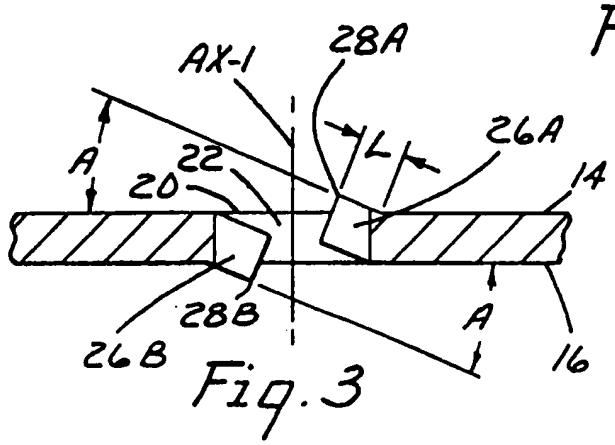

Fig. 3